Micro and ultrafiltration of produced water aimed at reinjection

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Introduction

This research project is aimed at the implementation of membrane separation technology in oil and gas offshore applications. The project focus on crossflow microfiltration and ultrafiltration separation and how oil removal and membrane are affected by the various chemical additives used offshore.

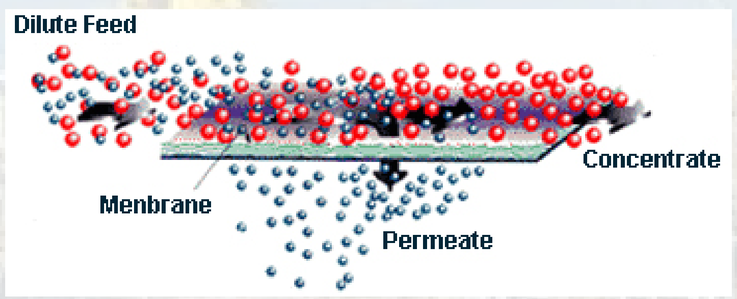

Fig. 1: Overview of crossflow filtration.

Objective

- Test the capability of crossflow microfiltration for oil in water concentration reduction.
- Evaluate oil in water concentration in permeate, membrane fouling and rejection capacity
- Evaluate the effects of offshore chemicals to the microfiltration efficiency
- Evaluate the effect of the different membrane pore size on concentration and fouling.
- Highlight operating parameters which reduce fouling phenomena in the microfiltration process
- Explain discrepancies between test pilot and laboratory experiments.

Challenges

- Creation of a representative synthetic produced water.
- Analsysis of produced water composition dynamics as function of time
- Understanding of the effects of additives influences in the micro filtration process

Materials and Equipment

- Synthetic water: Distilled Water, NaCl, Crude oil. Dispersed at 10000 Rpm for 3 minutes.
- Real Produced water from Halfdan.
- Additives: Polyaspartate, Phosphonic Acid
- Liqtech tubular Sic Membrane ⌀ 10x250mm, 5 mm channel. Pore size: 0.04 µm ,0.1 µm, 1 µm
- High Shear Stress Blender with Adjustable speed (Ultra-Turrax T25)

Experimental Setup

Fig. 2: Membrane Microfiltration Setup.

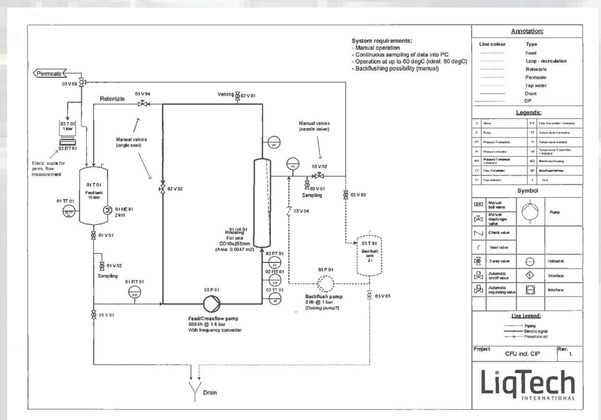

Fig. 3: The filtration setup uses a pump with adjustable speed to run the test in a constant TMP mode. The separation occurs through crossflow filtration. The retentate and the permeate flow joins into the feed in a recirculation mode.

Analytical Tools

- GC-FID: Gas chromatography flame ionization detector
- DelsaMax Pro: Light Scattering Analyzer

Preliminary Results

Feed Concentration (ppm)	Permeate Concentration (ppm)	Enhancement
25-50	7-30	20-60%

Fig. 4: Concentration of crude Oil in synthetic water without additives was analysed for sample of feed and permeate flow through GC-FID method.

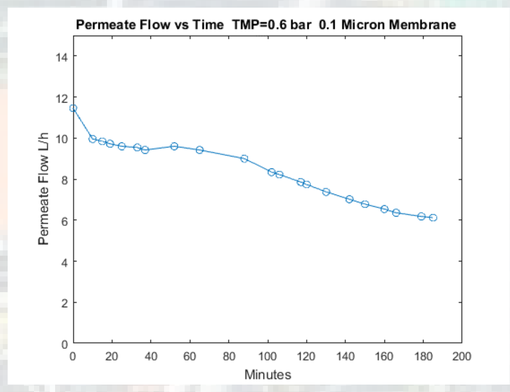

Fig. 5: Synthetic produced water was tested at a constant TMP of 0.6 bar. The graph shows the flux decline as function of time for 0.1 micron membrane for a feed flow with a concentration 30 ppm.

Feed Particle Size Diameter (nm)	Permeate Particle Size Diameter (nm)
450	250

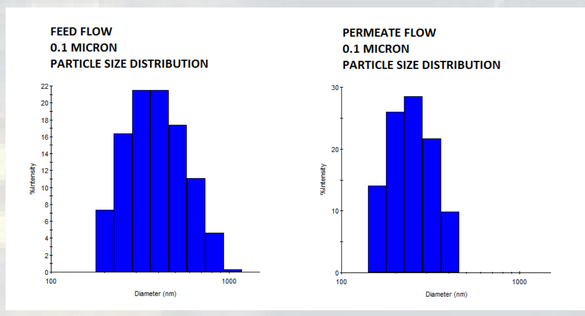

Fig. 6: Particle Size Diameter for both the Feed and Permeate flow using 0.1 micron membrane were measured through DelsaMax.

Future Research

- Synthetic water with chemical additives used in oil extraction and real produced water will be tested in the membrane setup.
- Oil in water concentration, oil droplet size and membrane fouling will be compared for the different feeds. The influence parameters in the performances of the technology will be studied based on the results.

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